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THE PROCEEDINGS
of
THE INSTITUTION OF PRODUCTION ENGINEERS

The Official Journal of the Institution of Production Engineers

Members are requested to correspond with the Editor upon matters of general interest. Letters may take the form of descriptions of unusual plant or tools, workshop methods, production problems, or organisation systems. Only in exceptional circumstances will proprietary articles be dealt with editorially. Manufacturers wishing to draw the attention of the Institution to the merits of their products are invited to use the advertisement columns of this Journal. Correspondence should be addressed as follows:

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THE FIFTH ANNUAL GENERAL MEETING.

(October 29th, 1926.)

THE Fifth Annual General Meeting of the Institution was held at the Engineers' Club, London, W.1, on October 29th, 1926, the chair being occupied by Mr. R. H. Hutchinson, the retiring President.

The Secretary having read, and the meeting approved, the minutes of the previous general meeting,

Mr. Hutchinson metaphorically bowed himself out of the chair and bowed himself in again. The explanation being that the Council, availing themselves of the rule which permits an individual to be elected to the Presidency two years in succession, had persuaded him to defer his retirement.

The President excused himself from giving a conventional Presidential address on the grounds that, suffering with a relaxed throat, he would need all his resources later in the evening. He briefly referred to the progress made during the year. Reference

was made to the loss of those early members who withered in the first blast of adversity; fortunately, the tenacity of those of stronger faith had carried the Institution to a new peak of prosperity. Both membership and finances were stronger, the Council were unremitting in their endeavours to improve the facilities for technical intercourse amongst the members, and it was announced that a strong syllabus had been arranged for the forthcoming session.

One thing the Council wished to develop was the opportunity for members to meet each other socially; with that end in view it was proposed to commence the business at each general meeting half-an-hour after the advertised time. (Unfortunately the proposal escaped the attention of many of the members, but it is hoped that this report will allay any uneasiness on the score of consistent unpunctuality.)

At this stage the President's voice played him false and he resumed his seat, the while the meeting expressed its sympathy in prolonged cheering.

In subsequent speeches, having reference to the proposing and seconding of votes of thanks, a plea was made to members to bring to the Council's attention any matter which was a cause of grievance. It was pointed out that to be of maximum use, criticism should be constructive; but, in any case, it should be directed to the Council and not cherished as a secret sorrow. The members of the Council were, individually and collectively, actuated by the highest motives; no one was infallible, and all would welcome help from any quarter, only asking that the sole interest to be served being the good of the Institution.

Formal votes of thanks to the President, the Council and the Honorary Secretary were then proposed, seconded and unanimously carried.

Straining his voice, the President acknowledged the votes and took the opportunity to expand upon the financial position. He said the Balance-sheet was healthy, but not yet strong enough to put into force one of the Institution's ambitions. He referred, of course, to the inauguration of a Premises Fund, and explained that, when the bank deposit showed a surplus over current requirements, it was hoped to institute such a fund and build it up until it was sufficient to erect a building worthy of the Institution.

This ambition was applauded by the members present, and the meeting then came to an end.

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THE THIRD ANNUAL DINNER.

THE THIRD ANNUAL DINNER OF THE INSTITUTION OF PRODUCTION ENGINEERS.

(October 29th, 1926.)

THE Third Annual Dinner of the Institution was held at the Engineers' Club, London, on Friday, October 29th, Mr. R. H. Hutchinson (the President) in the chair.

The toast of "The King" having been honoured,

SIR ALFRED HERBERT, proposing "The Institution," after expressing his thanks for the honour done him in asking him to propose the toast and for the welcome that had been accorded him, said he felt that the Institution of Production Engineers was a most important and valuable body. He was not, however, going to give a sermon on production, but it was a well-established fact and common knowledge that our prosperity, not as individuals, not even as a trade, but as a nation and an Empire, depended upon our ability to produce more effectively and more cheaply, and at the same time to allow those who are doing the producing—the workmen—to have better opportunities of improving their earnings and their standard of life.

Those who were responsible for production not only had a most interesting job but a grave responsibility that their efforts should be successful in the direction in which they were intended to move. The work of the production engineer was steady, patient development work. It was not given to everybody to be an inventor and to have original and brilliant ideas. He did not for a moment suggest that there were none of that class present that evening, but the average work which the production engineer had to do was steady development work, and it was only once in a while that a genius came along with perfectly fresh and new ideas. Sir Alfred then quoted several instances in relation to engineering in which a new idea had been suggested which had subsequently been developed over a long period of time by the steady development work of the rank and file in the manner he had already indicated. Amongst his examples were mentioned the original idea which led to the development of motor transport, namely, putting a wheel on to a cart; there were also the steam engine, the internal combustion engine and the slide-rest, all of which, he reminded his audience, led to the establishment of large and important industries. The whole history of the world, he said, had been that after some brilliant root radical idea had been put forward, this was developed over a long period of time by thousands of people,

and then later came some other important step forward. The point was that we could not teach ourselves to be inventors, and his belief was that the inventor, like the poet, was born and not ad ; like the prophet, he was inspired, and it did not come to many men in a generation to rise to the great height of producing an important radical invention. Therefore, in their quiet and humble way, production engineers must go on and assist the stream of progress by constant and steady improvement. That was one of the great functions of the production engineer.

The position of the production engineer was a difficult one to define. He personally imagined that there were dozens of different types of production engineers. For instance, there might be cases in which the works manager had to be his own production engineer, whilst there were also other cases in which each of the foremen was expected more or less to carry out the duties of the production engineer. Again, there were other cases in which the chief small tool designer carried on the noble work, whilst, if we went back to the old days, he would rather imagine that the production engineer was the "speed and feed" man. We wanted, however, production engineers with more important functions than those of the mere "forcers," as they used to call these speed and feed men. At the present time the position of the production engineer was ill-defined, because his duties in many cases were carried out perhaps by one individual nominally holding another post, or by a combination of individuals, but gradually the production engineer was winning his way to a definite position in the scheme of industry. He imagined that the ideal production engineer was responsible only to the works management and the works manager, but he had to run more or less in parallel with the small tool designer, and very largely in parallel with the foreman.

The production engineer, however, apart from his technical difficulties, was surrounded and beset by a good many human difficulties. For instance, Sir Alfred imagined that as the production engineer's job in life was very largely that of a critic, he was not likely to have completely unalloyed popularity unless he possessed qualities which softened the asperities of his job and made him acceptable even to those whose work it was his function to criticise. Human nature was human nature, and a difficult problem at that, and the successful men in business were those who had been most fortunate in dealing with the human problems with which they were surrounded. The production engineer must find a very large call made upon his tact, his patience and his good temper, and for that very reason Sir Alfred wished to emphasise those qualities, quite apart from the technical qualities which were necessary, as being very essential weapons in the armoury of the production engineer. Tact was the oil in the gear box; the longer he lived the more he felt the great value of

this indefinable quality, and whichever aspect this matter was regarded from, they must agree that tact was one of the tools of the production engineer.

He knew that production engineers, in the ordinary course of their work, were " up against it "; a process was going on and they wanted to improve it, but every conceivable objection was raised. People did not want to be disturbed. They liked to go on quietly in the grooves which they had worn for themselves, and when somebody came along and said, " Now then, get out of this groove," they were all inclined to resent it. Therefore the production engineer must present his proposals in a very cautious way. He must not be cast down by the first rebuffs, but must be patient and persistent until he had persuaded those concerned of the value of the proposals. Then, probably, in about three weeks' time those who had previously been objecting would be going round the works and telling everybody what a fine thing they themselves had done. (Laughter.)

He personally was not a production engineer, but for most of his life he had been engaged in making machines for production engineers to play with. He was like the humble craftsman who made the piano, and the production engineer was the genius who came along and got music out of it; many cases came to his memory in which the production engineer or the user of machines had been able to get far more music and far better production from them than the maker had ever dreamed was possible. In that respect a debt was owing to the production engineer, who was the irritant, the stimulus and the restless spirit. The attribute of divine discontent was the most necessary stimulant that industry could possibly have.

The President had been telling him of the progress made by the Institution; that it should have a membership of 500 was really wonderful, and the Institution had certainly made a very fine start. It was inevitable that its meetings should result in a great deal of good, not only to the members themselves, but to the industry in which they were all engaged. It was a great thing to rub brains and rub shoulders with other people who were doing the same job as one's self in another sphere, and it was very much easier, after an exchange of ideas, to go home with some thought given by a friend of a thing accomplished. For instance, he himself that very evening had learned from the President all about Babbitt metal, absolutely for nothing. As a matter of fact, Babbitt metal had been one of his great problems. Thus it was that by meeting people regularly one could often get an idea in an hour or so, when otherwise it would be necessary to shut one's self up in an office perhaps for days with a sheet of paper, trying to work it out. There was even now too much tendency for people to shut themselves up in water-tight compartments, and not go

into the world and see what is being done in the market place. Meetings such as those of the Institution of Production Engineers were an exchange of thought, and in that exchange of thought lay profit to him that gave as well as to him that received. He gave the toast of " The Institution " with the very greatest heartiness.

MR. H. S. LOCKER proposed " The President," and said that Mr. Hutchinson had filled the office in such an admirable manner during the past year, and had rendered such good service to the Institution, that it needed no further remarks of his to commend the toast.

THE PRESIDENT, responding to the toasts, said he regarded that night as a red-letter night for the Institution, because they had with them Sir Alfred Herbert, who was their Honorary Member, and it was very flattering to think that Sir Alfred had found time out of his busy life to spend a few hours amongst them and to tell them all the encouraging things that he had about production engineers. Sir Alfred had intimated that the production engineer must live in a state of glorious discontent, and he personally could not help feeling that really that was the salt of their lives as engineers, namely, that there was always something more that they could discover, something more to occupy their minds, something that was worth living for. He had a relation who was a stockbroker, who went down to his office in the morning reading about stock and share quotations on the way, spent his day buying and selling, and then went home again in the evening without much more to think about. Just think of the emptiness of such a life as compared with that of the engineer! There was hardly a thing produced in the world which did not bring to the mind of the engineer some aspect in which machinery was used for its production, and so provided him with some new interest all the time. Sir Alfred had also mentioned that inventors were inspired. He personally was one of those unfortunate people who was at one time, when he was young, very proud of the fact that he had taken out over a hundred patents, but he had realised that if inventors were inspired, at least they were not always in pocket. It was, however, the duty of the production engineer, whenever he saw an opportunity, to improve things for the sake of the profession and the industry, and to put his whole heart into the work. The production engineer had a great deal to thank life for, and in return for all that life gave him it was his bounden duty to put his best into his work.

Last year, at the Annual Dinner of the Institution, he had spoken at some length on the position of production engineering as a profession, and on the present occasion he did not propose to deal with the professional side, but to refer to the position the production engineer held as a link between employers and their labour. From that point of view the production engineer could

be of very great service to the country to-day. Probably to a great extent production engineers were the senior members of most executive staffs who came into direct contact with the work of the producers in the shops. In that respect they ought to appreciate the responsibilities attached to their position. Never in the history of this country had the necessity been so great as it is to-day for a united and determined effort on the part of all right-thinking citizens to instil in the minds of the workers a feeling of greater contentment, and, what was more important, a feeling of greater stability than exists at the present time. Never in the history of the trade union movement also did a greater responsibility rest on the accredited leaders of labour than is the case to-day of trying to instil in the minds of labour a feeling of greater trustfulness and a more conciliatory frame of mind than exists to-day. We were still experiencing, in the coal strike, the terrible results of the misguided leading by a few extremists of a body of good, hard-working, intelligent men. He did not wish to discuss in any way the rights or wrongs of that particular industrial dispute. Everybody had their own opinions on that, but he did not believe that there is another country in the world in which such a thing could occur, and, what was more, he did not believe there is another country in the world that could face such a terrible crisis with the wonderful calm and equanimity that this country had exhibited. This made him feel all the sadder, because if we only realised how we had been able to weather the storm with perfect confidence, then to what wonderful heights of prosperity could not this country rise if we could cut out that canker of mistrust and discontent which exists to-day, a canker which was gnawing the very vitals of our industrial foundation, the whole structure of our industrial system in this country. There was a work which all those present could go out and start at once, namely, to endeavour to remove the misunderstanding on the part of the working man. He received many letters from working men, and only that morning he had received one from a man in Coventry, which explained and described how men wasted their time deliberately in the works, and thanked him for some remarks which he had made in Coventry a few weeks ago on that very subject; the letter also urged the necessity for propagating the doctrine, and urged him to continue to endeavour to bring about a change in this attitude of mind on the part of the workman. Continuing, the President said he felt that as production engineers and men of intelligence they must use the intelligence which had been given to them with that one point always in view, that it was their duty to try to teach the working man that he was not only doing something against his employers, but that he was doing something to the detriment of his own nation, and that as a patriotic citizen he should change his ways. That could only be done by example.

There were probably not many people who realised that one out of every three people in this country was dependent entirely upon our overseas trade to-day, but it did not require a very clever man to realise that, no matter what we did in this country, if we were to sell in the markets of the world we must compete. Already we could do it in quality well enough, but if our workpeople would only do the right thing we could also easily compete in price. Therefore, he asked production engineers to keep that aspect in mind always, because it was one of the most crying needs of the country to-day. Let us first of all think of our country, and when we had got that on the right footing and had done some good work—and it only required a small seed to grow into a big tree—then let us think of the other things he had mentioned last year about the establishment of the work of the production engineer on a professional basis. First of all we must think of the welfare of the community as a whole.

Mr. J. D. Scaife, proposing "The Guests," said the Institution was very proud to have among them that evening such men as Sir Alfred Herbert, Mr. Gordon England, Mr. Vernon, and others. He was certain that Sir Alfred's remarks to them would be an inspiration just as in the same way, ever since he had been a boy, the work of Alfred Herbert, Ltd., had always been a very great inspiration to him. He looked upon Sir Alfred Herbert as the father of the Institution, not only because he was an hon. member of the Institution, but because he had started 30 years or more ago to make accurate machine tools when some of those present were taking their food out of a spoon, and some had not got even as far as that! For these reasons, therefore, they felt very grateful to Sir Alfred for finding time to give some interest to the work of the Institution. Whilst he himself had not the time now to give to the affairs of the Institution that he had had in the early days, he did endeavour to carry out in his business all the principles which the Institution taught.

When the Institution was started a few years ago those concerned with it almost apologised for coming forward. Some of the other institutions wanted to take production engineers under their wing because it was thought that they could not exist alone, but production engineers said they would sink or swim by their own efforts; they said they were going forward or going down. Now that they had got to their present position they must take a firmer attitude. They were not going to apologise for their existence; on the contrary, they maintained that they were absolutely essential to the prosperity of the country. They came in between the employer and the workman, and they must say to the employer that the right plant must be installed, and to the employee that the right effort must be put forward, otherwise it was no use. Deputations had been sent to America and had come back and

reported, but he could not help feeling that the right kind of man had not been sent on these missions, because although they reported, and their visits received a certain amount of publicity, nothing more seemed to have been done. The usual type of man sent could not see both sides of the question, and he was convinced that if members of the Institution of Production Engineers were sent on such visits and reported at once to the Government, some good would follow.

He was not a believer in Government interference in business, but there was one little thought which he would like to put forward. At the present time the factory inspectors went round works to see that safety-first appliances were in working order, but there was nobody who visited the works to see that manufacture was being carried on in the most efficient way. He could not help thinking that it would be rather a good thing if somebody did go round and point out to manufacturers that better machines could be obtained for particular processes than those actually in use, and to fine them for using inefficient machines. (Loud laughter.) That would be a far more sensible thing than fining manufacturers for not having a guard on a machine which the workman either does not want or will not use.

SIR ALFRED HERBERT: He would have to find out whether the machine tool man had got at the official. (Renewed laughter.)

MR. SCAIFE, continuing, said he would like to give a little advice on another matter. There were present at the Dinner representatives of the machine tool trade—merchants and makers—and he would like to say to the sales people present that they should get to understand the machines they wanted to sell and then send men round to demonstrate what could be done. These men however, should not merely demonstrate what their machines can do and then come away; they should not leave the premises until they had got an order. If anybody present had a better machine than anything he (Mr. Scaife) was using, he would undertake that a representative would be seen and the machine thoroughly investigated. The salesman should not be satisfied with seeing the buyer and the buyer saying that the machine was not wanted. The salesman should have instructions not to leave until he had a definite answer from the managing director, and even if he got put out by him the salesman should come back in a few days' time. (Loud laughter.) The fact was that an alteration in tactics was necessary if up-to-date machinery was to be used in engineering works. There was no use being "nice" about these things. We must accomplish things and not be satisfied with merely an attempt. Again, to production engineers he would say that they must not let the buyer stand between them and the salesman of up-to-date plant. If the best plant was denied them, then production engineers should simply refuse to

work—if the employer would not appreciate that by putting in newer plant he would be saving more money than he would get on his capital if left in the bank. (Renewed laughter.) If all production engineers did this, then it would be impossible for these inefficient firms to get production engineers, and they would be compelled to scrap their old plant. He said this quite seriously. If it was impossible to get the plant which the production engineer knew was necessary, then he should start to design it himself.

Referring to English bearings, Mr. Scaife said he had been told that they were better than the bearings that could be made in America. He did not know whether that was true or not, but he was also told that bearings were very much more expensive in America. In these circumstances why did not we export more? Perhaps there was something wrong with the sales department, but, in any case, it was evident that we should be able to do something better than we have. He sometimes felt that we are a little bit lacking in nerve. We had been brought up in the idea that things were done so well in the States that we simply gave up fighting them, but we must not give up the fight. The note he wished to strike was that we must keep on, and if production engineers could not get the plant they wanted in one way, they must get it in another. If the rivetting hammer would not do, then they must fetch the sledge hammer out of the smithy and break something; then it would be essential to have new tools.

Mr. Gordon England, who had made such a name for himself in the racing world, was present as the representative of the automobile trade which, as had recently been said, was the one bright spot in British engineering at the moment. Those who had been to the Olympia Show must appreciate that there was nothing much wrong with the automobile trade, whether it be expensive touring cars or very small cars, and if representatives were sent out with a vigorous policy to sell these cars we should very soon get back some of our export trade. If what he had said had the effect of inspiring some of those present to increase their output and bring the cost down so that we could compete with the foreigner, he would be exceedingly pleased.

Mr. E. C. Gordon England, replying to the toast, said he had certainly learned a lot since his recent acquaintance with the Institution of Production Engineers, and the speeches they had heard that evening had been exceedingly inspiring. Speaking on the work of the Institution as a whole, and the relations of production engineers as regards the workpeople in the shops, he said that it must be recognised frankly that the profession of the production engineer—and production engineering must now be ranked as a profession—must hold a very high position in the country. A great deal of the trouble in the industrial world at the present

time was due to the fact that the production engineer had not existed in the past in a professional capacity. The production engineer was responsible for the finest machines in the world, namely, the British working men, and yet the position, to his mind, was farcical inasmuch as nothing had been done to protect these wonderful machines. This was the very thing which the production engineers should take into their hands. It too often was overlooked that the human machine required far more careful handling and looking after than was necessary when dealing with materials, because, after all, the human machine would always be the governing factor in manufacturing processes. Therefore, he impressed upon production engineers that if they only kept their best machines efficient, namely, the workmen, then they would get the output required. He maintained, without fear of contradiction, that the human machine at the present time is the least studied machine in any factory organisation. A great deal of money and time was spent in looking after machine tools and increasing the efficiency as regards feed and speed, so far as the tool itself was concerned, yet at the same time the human machine was neglected. Much had been said about production engineers being interested in welfare work, but that was a wrong term altogether, because ordinary welfare work was of no avail to anybody as it was carried on in the ordinary way. What was necessary was a far more intimate study of the human factor in industry, because the human machine could be made the most efficient of any machine, whereas at present it was not studied in the manner it ought to be. It was for production engineers to take this matter in hand and decide for themselves the best course to adopt. His own experience had shown that the human machine is capable of giving all the service that can reasonably be expected of it, provided the workpeople were treated in the right way. This aspect of the matter was far more important even than getting the more improved machines, which it had been suggested are available.

NEW COUNCIL MEMBERS.

(October, 1926.)

As a result of the ballot taken at the beginning of the 1926-27 Session the undermentioned members were elected to fill vacancies on the Council :—

MR. E. W. HANCOCK.
MR. N. GERARD SMITH.

EDITORIAL.

(October, 1927.)

DURING their careers, Members of our Institution will have experienced at least one circumstance in which everything, previously considered sacrosanct, has had to be sacrificed to attain the end in view. Those engaged in the automobile industry have come to regard this as an annual event, commencing some weeks before, and only ending at the moment the doors of Olympia are thrown open to those who throng the Motor Show. Foremost amongst the items laid on the altar of expediency are records; material requisitions, bonus cards, overtime sanctions, and other things being cheerfully thrust into the background. When the objective has been reached then are they disinterred, fashioned in the approved manner, and presented to the Powers that Be.

This analogy explains why the Proceedings of the 1926-27 Session are only now making their appearance. For the sake of the historian, who, in A.D. 2021, will be delving into the records of the Institution to prepare a Centenary Souvenir, we make this explanation. Our Secretary, faced with making a decision as to the relative importance of development work or records, wisely decided to put records in abeyance. Under the direction of the Council he has carried out development work so successfully that the enlarged Institution demands all his energies. To preserve a record of our work in General Meeting we have undertaken the responsibilities of Honorary Editor. 'Tis a journalistic sin to quote the hackneyed, yet we throw ourselves on your mercy with "Don't shoot the pianist—he's doing his best!"

Our analogy falls down at the point: "Fashioned in the approved manner." It is essential that records of papers read and discussions held should appear under the date of the event, and this date should bear some relation to the remaining items in the same issue of the Journal. Until we have overtaken the arrears this will not be so. To avoid confusion we purpose publishing every item under a date until such time as record treads hot-foot upon the heels of performance.

In another part of this issue we refer to the formation of a Birmingham Section, one outcome of the development work referred to above. We hope—nay, having faith we trust—that this is only one of many sections to be added to the two already in existence: London and Coventry. The eye of faith peers beyond the horizon of this decade, even beyond this generation, and sees a network of sections, spread over the Empire and, through the Central Council, linked with kindred organisations throughout the world. In those days London's claim to precedence in the Institution may only rest on seniority, but that claim will achieve her

Continued at foot of page 17.

VISIT TO THE AUSTIN PLANT, BIRMINGHAM.

(June 24th, 1927.)

ABOUT forty members of the Institution, responding to the invitation of The Austin Motor Co., Ltd., converged upon Birmingham and proceeded by char-à-banc to Longbridge, the rural district which is the home of the Austin. If "Happy Homes Make Healthy Babes," then Longbridge supplies the reason for the numerous sturdy progeny of the Austin Company.

Sir Herbert Austin extended a welcome to the party and, before handing us over to the very efficient guides, promised to meet us at the tea-table. It will be as well at this stage to give a résumé of Sir Herbert's tea-time remarks, for they explain the lack of technical detail in this report.

Outlining the history of the Austin Company, Sir Herbert went on to say that they are very conscious of their own shortcomings. He asked us, therefore, not to criticise, as Herculean efforts are being made to bring the plant to a high degree of efficiency. Reference was made to the acreage covered by the works, and the intention to add to that within the next twelve months. Over 10,000 workers are employed, and Sir Herbert expressed the intention to take at least another 2,000 off the unemployment registers as his plans develop. He thought he could justly be proud of the excellent relations between himself, his management and his work-people. This state of affairs was attributed to the confidence which had been built up in the fairness of the administration of the payment by results scheme. The party had ample evidence of the good spirit permeating the Austin employees. In all departments work was proceeding with a swing, happily, expeditiously, and with a marked absence of undue disciplinary supervision. A sustained murmur of applause interrupted Sir Herbert's remarks upon this subject, indicative of the Institution's interest in the humanities of production in addition to the necessary absorption in technique.

Sir Herbert, before concluding an informal yet intensely interesting address, said how much he abhorred the "closed shop" policy; he felt that only by a free intermingling between executives could this country hope to compete in the world's markets. We all, he added, have more to learn than we have to teach. It was on this note that his remarks were brought to an end, a note which he hoped would inspire the members of the Institution to make their discussions as free as possible, in order that their usefulness to the community might be exploited to the utmost.

The President, Mr. R. H. Hutchinson, in addition to voicing the sentiments of the members, also struck a personal note when he told Sir Herbert Austin how much he had appreciated the opportunity to renew old acquaintance with a plant where he had spent so many happy years. Referring to the progress made since last he had visited the plant, Mr. Hutchinson said that the members needed no stronger evidence of the sterling qualities of the man who had so skilfully piloted the Austin craft through the dangerous waters of the post-war period. Whilst men of Sir Herbert's stamp controlled the automobile trade of Britain, then we could confidently expect an expansion of trade, both home and export, a decrease in unemployment, coupled with a marked improvement in the lot of the people who brought their muscles as a contribution to production.

The first department visited in the tour of the plant was, appropriately, the Tool Room. Earlier in the 1926-27 Session, Mr. Armitage, of the Austin Company, read a paper in which mention was made of a bonus scheme in force in this department. The fact that the Austin Company are self-contained, to the extent that they do their own foundry and forging work, gave many members an opportunity to study the manufacture of forging dies. It was apparent that bonus systems do not kill craftsmanship.

The Machine Shops showed that whatever step may next be taken in installing new plant, it will be done with full knowledge of the possibilities of varying methods to attain the same end. Milling *versus* Planing, Turrets *versus* Autos, and so almost indefinitely throughout the plant. What wonderful data there must be in the shop records of the Austin Company! Even within a process, *i.e.*, Honing, we noticed a variety of machines and appliances. With the multiplicity of combinations of surface speed and reciprocations obtainable there should be available a fund of information of great value.

Conveyor systems, each designed to handle a particular component, greatly facilitate flow production. The system handling the connecting-rods caused some comment on account of its height; it was thought that when it becomes necessary to analyse operator fatigue on this line it will be shown that a great amount of energy is expended in reaching so high.

Whatever shortcomings of the plant Sir Herbert had referred to, it was obvious that the Inspection Department insists upon a high degree of accuracy, the operators' gauges are good, easy to handle, and free from ambiguity, on top of which the inspection devices make assurance doubly sure.

To attempt to enumerate even all the processes which merited attention would be too severe a strain upon the limited space at our disposal. We can assure Sir Herbert, in reply to his request that we refrain from criticism, that at Longbridge there is more to

praise than to blame. The ambition of every member who was of the party is that the Institution takes the first opportunity to avail itself of our host's speeding words: "Come again."

One last glance at Longbridge. As our party gathered itself together, those already in the char-à-banc watched about 9,000 (more of less) of the Austin employees line up to buy an evening paper. Before ten minutes had sped everyone was served; every transaction was for cash. *One* newsboy controlled this output. Truly, Longbridge air is vitalising!

INAUGURATION OF THE BIRMINGHAM BRANCH, INSTITUTION OF PRODUCTION ENGINEERS.

(June 24th, 1927).

FOLLOWING the visit to the Austin plant, the members of the party assembled in the Windsor Rooms in the Grand Hotel, Birmingham. Mr. R. H. Hutchinson presided over a meeting greatly reinforced in numbers by many engineers resident in Birmingham and district who were anxious to become acquainted with the objects of the Institution. These were so ably explained by the President that question-time brought a "deafening" silence.

Mr. Weatherly, Member, then proposed, and Mr. Sykes, Member of Council, seconded, that a Birmingham Branch of the Institution be formed. This was carried unanimously.

A difficulty arose concerning the election of officers, but the President, out of his wide knowledge of the men of Birmingham, suggested Mr. Hannay. That his suggestion was good was obvious from the unstinted applause by the people whose president he would be.

Mr. Hannay then took his seat at the right hand of the President, and suggestions and names began to flow more freely. However, the only other formal appointment made was that of Mr. Wright to the Hon. Secretaryship of the Branch.

Powers were given to Messrs. Hannay and Wright to co-opt members to their committee, and Messrs. Lacey, H. C. Armitage. J. H. Garnett, Geo. Williams, and J. G. Youngash, were called upon, and agreed, to render their services.

In less than an hour the formalities of inauguration had been carried through, the ease with which this was done being a tribute

to the sound preparatory work carried out by the President of the Institution and Mr. E. D. Ball, the Hon. Sec.

As an earnest of their good intentions, we observed the newly-appointed Branch President and Secretary, as we left the room, in solemn conclave. A correspondent informs us that this has continued (with intervals for work and meals) up to the present. We can well believe this. A draft copy of the Birmingham Syllabus for the 1927-28 Session has come into our possession. The subjects are good, and the presenters of the papers each an authority upon his topic.

Birmingham, by the multiplicity of its products, the diversity in the size of its establishments and the large number of people engaged in the science of production engineering, offers a tremendous scope for the Institution. From Birmingham we expect an influx of members of good report, we expect additions to our store of knowledge, and, lastly, we expect an increase in the social amenities of the Institution. Whilst men of the calibre of Messrs. Hannay and Wright are available, we are content that Birmingham will add to our prestige, our knowledge and our friends.

Enquiries respecting the Birmingham Branch should be addressed to the Hon. Sec.,

MR. I. H. WRIGHT, 138, City Road, Birmingham.

In the next issue of the Journal reference will be made to the first paper presented to the Birmingham Branch.

Mr. C. R. F. Engelbach, Works Director, the Austin Motor Co., Ltd., gave his impressions following a trip to the U.S.A., and his comments have already caused a stir in engineering circles.

His audience, one of the largest to attend any meeting of the Institution, included the President-Elect, Sir Alfred Herbert, and Sir Henry Fowler, of railway fame.

Editorial (*continued from page* 13).

nothing unless she can rightly take her place in the aristocracy of achievement. In those days each section will be self-governing, subject only to the jurisdiction of a Central Council elected by, and from, the members of the Section Councils. Happily, parochialism seldom attacks a young movement (the very fact of our existence bears witness to the urge placed upon our founders by older institutions), yet in our youth we should plan and prepare to shape our ends, so that elasticity of mind and organisation may be found in a body old in years.

THE APPLICATION OF MANUFACTURING METHODS TO NON-REPETITION WORK.

Being a paper presented to the Institution of Production Engineers on November 26th, 1926, at the Council Room of the S.M.M.T., 83, Pall Mall, London, S.W.1.

By H. C. Armitage (Member of the Council).

IT is only during comparatively recent years that a separate workshop technique has developed in this country, around what used to be called repetition work.

Engineers have generally regarded repetition or manufacturing as being of a lower order of their work, because more concern is there manifested with producing at a price, than is given to the actual development of a mechanism which could achieve its purpose better than previous accomplishment. In most works, the professional engineers are more interested in the design and performance of their product than in the actual making of it, and are generally content to leave this portion of the business almost entirely to their works manager and shop foreman. Thus they have no trouble and worry in arranging the making or building of it, providing their designs and constructions are accurately and well carried out.

This is a happy condition for everyone concerned, and operates well, providing that the only consideration is quality, and that accuracy and reliability in the product are the only conditions required to retain markets.

The production of machines in this manner—which, for the sake of a term, shall be characterised in the rest of this paper as "making or workshop methods"—has always been regarded as the safest way of developing engineering as a whole, and it is surprising how contented the workshop side of the industry has hitherto been to find satisfaction for their life-work purely in building machines to working drawings. The manufacturing engineer has apparently a more limited field. He develops a mechanism, then makes it as fast and often as he can. A plant must be established specially for production, and the more highly organised this becomes, so, logically, does the progressive improvement given by new designs restrict the evolution of the machine, because design must be subordinated to manufacturing facilities. Then, again, volume of output must be considered in order to meet keen competition, which will always arise for the simple reason that knowledge of production is a part of every scheme of

engineering training. The greatest difficulty, after once establishing a reliable mechanism, is to produce a better article at a lower price than competitors.

The producing side of the business is, therefore, of great importance to the manufacturer, and he is forced to give it equal or more attention than to the mechanism development side.

If these statements were entirely correct, we should find that general engineering works were always the foremost in the development of mechanisms, and that manufacturers were producing machines which were known to be behind up-to-date practice, but which could, nevertheless, be sold cheaply. This is certainly not the case, and it is found that manufacturing engineers have to be able to alter and develop their models equally with general engineers, and even sometimes against their competition.

The general engineering businesses in this country have had a difficult time since the war period for a variety of reasons, but principally because insufficient attention has been given to the production costs of their business, thereby encouraging the impoverished world to establish engineering works in non-industrial countries and produce goods for themselves at low and unskilled wages, rather than purchase a better machine from Great Britain at a higher price. Such countries are at an advantage by taking developed and perfected designs, because their problem is then only the one of production to which the fullest attention can be given.

The economic question in engineering businesses is, therefore, vitally important, and the pre-war situation, when markets were safe with any reasonable production costs, has entirely disappeared.

Engineering manufacture was started earliest by the Americans because they were forced to use unskilled labour, and make the most out of the small proportion of skilled men who were available. This, together with large resources of material, has made the United States into the highly industrialised country it is to-day. The former disability has thus reacted eventually to advantage.

Whenever American manufacturing competition has been felt in England, they have been unable to retain the markets after the British factories had risen to meet the situation. Take, for example, bicycles, sewing machines, motor cars, and now, it is to be hoped, typewriters. In every case, entry to the market was obtained earlier by virtue of a more highly developed manufacturing knowledge.

Is it not then advisable, since English manufactured products are able to hold their markets, to examine the characteristics these works have acquired with a view of their possible application in non-repetition works, and to enable them also to meet competition?

This is the object of this paper, and although nothing new will

be outlined, it is, nevertheless, hoped that the somewhat general examination of the subject will be helpful and stimulate thought upon what can be done in this direction.

Tabulation of Differences.

What are, then, the differences between making and manufacturing? Generally, the manufacturer has to deal with a comparatively small number of parts in large quantities, whereas the maker has to deal with a larger number of parts in smaller quantities. Repetition of the same article or design does not in itself constitute manufacture, because a lot of similar things can be produced by conventional workshop methods, whereas manufacturing is merely an evolution of specialised functions which grow to meet the conditions of the easiest means of accomplishment.

The following differences can be immediately listed :—

(1) Manufacturing has developed offshoot machine tools which can handle runs of work more economically, *e.g.*, centre lathes grew into capstans, then to automatics ; drilling machines developed multiple spindles, and generally the " standard " has developed to the " semi-special " machine.

(2) Jigs, machine fixtures, built-up tools, dies, pattern plates are fixed to machines to save cutting, handling, measuring, and fitting time.

(3) A limit system and gauges is used throughout a works.

These three features are a development of the technique of the business. The results from their development are shorter operating time, and the employment of unskilled or semi-skilled labour.

The remaining differences are those of organisation :—

(1) The manufacturing works is designed and arranged for a minimum of work movement.

(2) All work is paid for on a basis of payment against production, *i.e.*, piecework.

(3) Accurate planning is done, *i.e.*, work is time-scheduled to machines, output standards are set, and predetermination of costs, workshop efficiency, and even profits are measurable with almost mathematical precision.

(4) Concentration of effort and thought on a repeated operation develops inventiveness towards improvement of details of methods and product.

These differences are small compared to the basic one, viz., that the manufacturer always thinks in terms of larger quantities of the same component part, whereas the workshop engineer is generally burdened with the idea that he cannot get repetition, and that it is not, therefore, worth while trying to apply manufacturing machines or methods.

How, then, can the quantity idea be applied to a non-repetition works. The first analysis must start from the finished products to see what there can possibly be in common with a repetition works. It will be found in nearly all cases, that engineering works confine themselves to a certain line or several lines of business. That is to say, that although two of their machines may not be alike, yet the bulk of their construction is similar in size and type.

A works is not likely to be making a printing machine one day and a marine engine the next, followed, perhaps, by a steam turbine or a set of hydraulic pumps.

This seems obvious, perhaps, but it is a fact worth stating, because each one of the above is in a separate class, with a widely different requirement of finish, range of parts, and machine tools for producing them. This narrows the field of consideration slightly, but does not materially affect present-day conditions.

The next stage is to see how far it is practicable to put orders through the works for several machines at a time. This condition is now adopted by machine tool makers, and the majority of them build in batches of six, twelve, or more, if they can see a reasonable chance of quick disposal.

Parallel with this comes the question of how far price reduction will stimulate a market. (The manufacturer experiments a great deal in this direction, often at a serious loss.) This means standardisation of the product or its parts, and a reduction of the various models. There is frequently an unnecessary diversity of models which can be caused by a sales system, which relies on diversity or the customers' individual and peculiar demands. The latter will frequently give way to arguments based on better quality at a lower selling price. In any case, help must be given primarily by the selling organisation. Analysed records of models against sales are a powerful lever. It must be granted, however, that engineering works generally are far more alive to the value of standardisation than, for example, pottery or bedstead makers.

When the interwoven question of batch orders to the works and standardisation of models has been developed as far as possible, there is no more help expected from that section of the works which deals with the customer.

Works and Plant Layout.

The manufacturer has for a long time realised the value of grouping his plant into unit-machining and sub-assembly sections. It has been found that a division on the basis of groups of widely different components which make one sub-assembly is the easiest to organise and handle, although not the most economical in actual output from machines. It thus becomes an advantage to let machines be idle for certain portions of time in order to achieve

continuity of output, and this can be justified by regarding machine tools of a standard type as a safer capital item than stocks of partly finished components.

The grouping of similar machine tools is likely to give higher individual outputs from machines by working them fully, but necessitates larger supplies of work in progress. The maker must look at the problem in a different way, because continuity is not so essential, and he will have to accept the condition which the present-day manufacturer does not like, that is, must have the stocks of parts together with groups of similar machines.

In other words, the maker will have to arrange his plant on a basis of operations, rather than of individual components.

In some cases, makers sometimes have the opportunity of running fairly good sized batches of work through their shops. If they had the courage to drive all their machine plant with an individual electric motor, make a floor plate or slide rail foundation for their machines, it would be possible to rearrange their shops into line machine units in a few hours, and thus obtain true manufacturing conditions in respect of layout of plant.

Mobility of plant is one of the crying needs of both manufacturer and maker, and a plea is here put forward to machine tool makers to try and standardise their drives. Generally, their last consideration is the position of the driving pulley in respect of its relation to the length or width of the machine, and position of the operator.

Gravity and power conveyors are now being extensively used in manufacturing works. Their value lies in shortening the time (thereby minimising the stock) required to move a job through its operations and on to its final position in the product. Conveyors have also a psychological effect upon the workers, who can see the work in front of them, and this tunes up an organisation in every way. Loading, unloading, and waiting for trucks is eliminated, and work is kept flowing regularly instead of coming intermittently in bulky loads.

There is certainly an opening for them in ordinary workshops, and although difficulties may be experienced in selecting the type most suitable for their generalised requirement, the result will certainly justify the small capital expense and trouble that will be incurred.

Standardisation.

One feels that it is almost necessary to apologise for mentioning standardisation, but it is highly important when comparing a manufacturing business with one devoted to general engineering. The necessity for producing large numbers of parts by a developed jig and tool system forces standardisation of components, methods, time, and organisation, but no such pressure exists in the general

engineering works. It is, nevertheless, equally necessary, and the development of standardisation and assimilation methods are of prime importance. All such work can be handled easily by one man even in a large works. His efforts will be threefold: (1) to show where slight adjustments of design will eliminate a stock item, (2) to select stock items, (3) to publish information throughout the works in regard to stock items.

There is a very distinct movement in most works towards decentralisation, and it is not uncommon to find five or six self-contained departments in one large works. In every department there would be a stores, and it can be imagined even with small items like bolts, nuts, and set screws, what enormous stocks can easily be carried. There would be about 12 diameters stocked, and each in, say, 12 different lengths. Multiply this series by the black, the bright, the snap heads, the square heads, the hook bolts, those with gas threads or B.S.F. threads, and it will be found that a thousand stock items can rapidly be accumulated. If there are six stores, the 1,000 items becomes 6,000. The standardisation system, by allocating certain sizes to certain stores, would probably eliminate this down to 500 items only. By following up the bolts with pins, dowels, studs, keys, handwheels, pulleys, gear pitches, clutches, striking gear, paints, varnishes, oils, pressure gauges, shaft tapers, name plates, etc., some small idea of the economies resulting from detail standardisation can be obtained.

Tooling standards are the next in importance and methods of producing certain machined parts must be recorded. For example, what holes should be cored by the foundry, or left solid to be drilled by the machine shop. Again, the size of hole at which reamer finishing ceases to be profitable, etc. This phase of standardisation should be handled by the planning and rate-fixing office.

Management and organisation methods can also be standardised with very economical results in respect of time recording, labour grading, proportioning of supervision, works stationery, etc. The chief difficulty surrounding standardisation is its assimilation, not the actual setting of the standard, although that often means a lot of hard work.

Operations.

The manufacturer of to-day has freed himself, by bitter experience, from a lot of misconception in respect of economical production. Only a few years ago, the main object in most machine shops was to run a job at its highest possible feed and speed in order to obtain work at the lowest cost. This, unfortunately, meant (1) that there was an unnecessary wastage of cutting tools, (2) obscurity of the consideration of handling time, which is the

main issue affecting cost of output, and (3) developed multi-operation or special-purpose machines to an unnecessary degree.

It is not the object here to plead for retrogression in respect of cutting speeds or feeds, but rather to show the futility of making a fetish of them. On the majority of manufacturing operations it is not necessary for an operator to do more than load and unload and clean down and restart a machine. This means that when he is not actually handling a machine, he is standing by watching it cut. For example, if a machine takes 12 minutes to perform a cut, and the operation can be handled in three minutes, then an operator could look after four machines. If cutting time is reduced to nine minutes, he can only look after three, but if, alternatively, handling time had been reduced to two minutes, he could then look after six machines without extra effort. The proposition in practice is not quite so arithmetical as it has been stated, but it is not at all uncommon for an operator to work six machines and each of a widely different type.

This has the effect of discouraging continuous loading machines, but develops the string milling machine, auto chuck lathes, cradle jigs, mandrel work, and similar tools which require standard, or semi-special, rather than totally specialised machines. The manufacturer's line of development, then, is mainly in the direction of handling time reduction, but the maker's is one of a different nature, but not the obsession of feeds and speeds. It is change-over time or resetting of machines. Once this can be thoroughly grasped, the whole policy of his machine shops would be concentrated on the question of keeping the machines cutting whilst they were being set up for fresh jobs, and the organisation of his shops would be concentrated on the problem of changing over from one job to another.

What would be some of the broad effects of this? Surely, the banishment of milling machines in favour of travelling head shapers with two tables, the development and use of L box bed radials, the division of operations into groups, *e.g.*, centring, mandrel-loading, sliding lathes, surfacing lathes, boring lathes, and shaft sizing on grinding machines. Sizing in the machine shop is the only skilled job. Therefore roughing-out and finishing shops should be clearly separated.

This practice, although correct in theory, generally proves a failure in its operation on account of the difficulty of synchronising the setting-up time with the actual work moving and machining operations. This is not insuperable if a suitable planning system is installed.

There are generally very great possibilities in a general shop for a system of jigs and tools which will cater for small runs of work. If the opportunity is not there for larger quantities, of, say, 100 or 200 off, the provision of a jig is neglected.

Take, for example, a horizontal boring machine of the Kearns type which is one of the most useful of the workshop machines. If there are six similar castings to be bored, a jig plate for sizing the diameter and position of the bores will more than pay for itself, and the work produced will be better and more accurate.

There are numerous ways of making built-up and universal jigs very cheaply, which will pay for themselves with very short runs of work up to 25 off, and the modern jig boring machine is of very great assistance in this direction, as it materially reduces tool costs where they are the most expensive.

The possibility also of designing one jig to cover several different parts is frequently neglected.

The recent development of capstan and turret lathes where the steady for the turret is now regularly fixed outside of the axis of the work, is of great assistance in short runs of work, because piloted boring bars are not then essential. They are the only special tool required. The tool equipment can thus easily be standardised, and a well-arranged set of tools will cope with almost any job that comes along.

In the forge there are many opportunities of using tooled up plant for short runs. The forging machine, which is the biggest cost reducer in the manufacturing shop, can be equipped with tools very cheaply, and for short runs tools may be made of chrome nickel steel and left unhardened. On such machines it is not impracticable to heat a pair of tool blocks, and, by using a model of the piece required, squeeze an impression into them on the machine, and from that produce a short run of parts almost as well as if the tools had been carefully cut and hardened.

In the foundry, again, a pattern plate system may be used extensively on jobbing work if carefully developed. The patterns will be of wood, and fastened on to standard steel plates which may be used over and over again and built up as required.

Piecework.

The subject of piecework has been very thoroughly thrashed out during the last few years, and it is difficult to believe that there can yet be works existing where it is not in practice. It does not represent, by any means, the last development of wage payment methods, but new schemes will be built upon piecework in the same way that piecework was developed from time rates. The application of piecework has been hampered from its earliest days by the conception of limited earnings, disguised price cutting, and an expectation of something for nothing on the part of management and men. Again, the application of extreme time and motion study in loosely organised works has provoked irritation amongst the workers, and excessive overhead charges for the management.

The results of "straight" or 100 per cent. piecework in one works, where these disadvantages have been continuously eliminated, show that cost of production has decreased by 71 per cent. and that the workers' earnings meanwhile have increased by 128 per cent. during the last four years.

These results were so encouraging that it was decided to place the tool room on piecework. This has been an unqualified success, and during twelve months' operation the output therefrom increased by 24 per cent., whilst the number of workers required decreased by 19 per cent. This shows a net reduction in tool expense against an increased output of about 25 per cent., and a reduction of cost of tools of 25 per cent. At the same time, the tool makers and machinists have increased their wages by an average of 52 per cent., and the surplus men have enabled the department to undertake new lines of service to the works.

A tool room cannot be called a repetition shop, and the results there show what can be obtained in every jobbing shop.

The introduction of piecework into a day-work shop throws an enormous strain immediately upon the shop organisation. All the foremen and chargehands find at once that they have to have jobs and instructions ready for men who will not countenance waiting about, and who, if not attended to, will openly lounge so that they can be seen by the management.

Piecework, therefore, is one of the finest organisers in the world, and, furthermore, ties everyone concerned, because a piecework price cannot be put on a job where there is the slightest vagueness in regard to requirements. It kills any possibility of setting out on a job without knowing quite how to carry it through until well on the way with it.

Once piecework has got into working order, the necessity for organised planning is apparent.

Planning.

In the majority of works, planning is still regarded as a novelty, and its value not properly understood. If properly applied, it is the greatest money-saver that can be introduced into a works, and it will easily save twice as much in a "making" shop in comparison to a manufactory, where it is not quite so essential, as the work, to some extent, plans itself. No manager would ever dream of allowing a machine operator to bring material from the stores and deliver it again after doing the operation to it. This carrying work is always performed by a lower grade of worker—certainly not the machinist. Planning accomplishes the same economy in respect of the foreman or chargehand. Whereas such a man is limited in respect of the number of men he can look after, by the time he is occupied in deciding methods, suitable machines, and the order of putting the work into execution, so would one fore-

man and another executive specialising on planning, accomplish the supervision and execution of at least three foremen under the previous conditions. Planning, also, can largely, if not wholly, cut out progress systems. This has, unfortunately, caused a certain amount of confusion in the minds of many people who think planning is the same as progress work.

Before work of any sort can be attempted, a lot of decisions have to be taken in regard to it, particularly in respect of the shop and machines which it will occupy, the methods by which it will be accomplished, the time it will take, the degree of facilities and tools that will be necessary. There then remains the simultaneous provision of an empty machine with an operator wanting a job, the work on the spot, together with all the necessary equipment facilities and instructions.

In general engineering works all this is expected from the foreman, to whom it is really a side-line, and he has to give decisions in all such respects without full acquaintance of all the facts to guide him. In many cases, particularly when skilled men are employed, he leaves the bulk of this work to the operator, who spends a lot of time puzzling over drawings, inventing his clamping equipment, deciding his locating faces, etc., and leaves his machine idle whilst so doing.

Some idea of the economies which would result from the introduction of a planning system can be gauged by imagining the difference in cost between building the first model of a machine compared with the second one. In the second machine all the operations connected with it have remained in the minds of foremen and workmen, and the job goes through without difficulty. Under planned conditions the first machine (except for matters of design) would go through the works with equal facility.

There is another aspect of planning which is frequently not fully appreciated, and that is, the possibility it gives of measuring machine capacities and predetermining costs, deliveries of work, labour requirements, and minimising material stocks. Planning should be two-fold in its action. (1) A centralised office to deal with machine allocations, processes, design of tools, and calculate piecework prices. Then (2), in each department (or, say, to every 200 men on jobbing, or 600 men on repetition) it would have a representative in the shop in the form of a ratefixer with a clerk to operate a machine load board. Clock clerks and progress men could be taken out of departmental work, as the clock cards would be prepared in the central office to be used as required, and used in the planning scheme.

There are other details of management where manufacturing works can give a useful lead to the general engineering works.

They are as follows :—

(1) Purchasing against material schedules for estimated price and dates of actual requirement, thereby economising stocks.

(2) Flow of material through the works—helping rate of capital turnover.

(3) Purchase of supplies against specification—*e.g.*, coal against heat units and ash content.

(4) Control of costs against estimates, leading up to an annual budget for the oncoming year's working.

It has been difficult to cover all that can be brought within the enormous scope that this subject gives. If this paper succeeds in opening lines of thought in a few of the directions that have been so briefly outlined, it will perhaps have been of practical value.

The discussion on this paper will be recorded in the next issue of the Journal.

At an Extraordinary Council Meeting, held prior to the Fourth Annual Dinner on October 21st, 1927, a number of applications for membership was received, and the following were elected :—

Members.

Mr. H. Allen, D. Napier & Son, Ltd., Acton, W.3.

Mr. C. R. F. Engelbach, Works Director of The Austin Motor Co.

Mr. E. C. Gordon England, of Gordon England, Ltd.

Mr. D. Wilkinson, Austin Motor Co.

Mr. E. J. Griffin, Alfred Herbert, Ltd., Coventry.

Associate Members.

Mr. J. H. Brearley, Austin Motor Co.

Mr. C. A. Clarke, Leyland Motors, Ltd., Kingston-on-Thames.

Mr. R. Martin, James Archdale & Co., Ltd.

Mr. G. E. A. Still, Citroën Cars, Ltd., Slough.

Mr. A. Tuckley, Pennant Manufacturing Co.

Associate.

Mr. J. M. Sinha, Model Industries, Dayalbagh, Agra, India.